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“Observation of Saharan Territorial Structures and Dynamics”

Yaël KOUZMINE, Hélène AVOCAT, Marie-Hélène DE SEDE-MARCEAU

**Yaël KOUZMINE,
Hélène AVOCAT,**

Marie-Hélène DE SEDE-MARCEAU

Laboratoire ThéMA UMR 6049 CNRS – Université de Franche-Comté

32, rue Mégevand

25030 Besançon Cedex

France

yael.kouzmine@univ-fcomte.fr

avocathelene@yahoo.fr

marie-helene.de-sede-marceau@univ-fcomte.fr

Abstract: The authors deal with the best way to tackle the problem of mutations that affect Saharan spaces (environmental, economics) and their consequences on different scales. The final objective of this paper is to propose theoretical and more operational elements about the observation of those mutations (modeling, indicators) regarding heterogeneity and specificities of these territories. An observation structure of those territories (by territory we consider geographical space and actors) could permit to increase knowledge and support dialogue between Land settlement actors and researchers. Those reflections become integrated in Algerian government’s will to develop “the best synergies for the development”, by increasing “good governance” and participation (National Scheme of Land Planning).

1. INTRODUCTION

Sahara spreads over 2.000.000 square kilometers (which constitute the most part of the Algerian territory). Nevertheless, according to the 1998's census report's data, the Saharan population represented about 10 percent of the national one. Also Sahara space is very low populated, it's been subjected to important mutations during the 20th century. The increasing urbanization is one of the most important factor of these mutations, and has a lot of consequences (spatial, environmental, economic, politic). Indeed, 63% of Saharans were urban in 1998 (Côte, 1998), whereas the urbanization rate was about 10% in 1954.

Urbanization's processes and territorial mutations in Algerian Sahara are complex and depend on the interaction of several elements; such as national and international migrations, economic development generated by hydrocarbons and expansion of capitalistic agriculture (Bisson, 2003). The strong demographic pressure which characterizes Saharan territories generates problems not only in urban management, but also to a larger extent in landplaning processes. Those problems are economic, social, environmental and tends to reconsider development models and landplaning policies that have regulated the territorial dynamics until today.

Indeed, "territorial tenseness" constitutes a recurrent element in Algeria, especially in Sahara due to the specific environment and socio-spatial practices of populations. Nowadays, Algerian landplaning policies tend to respect principles of sustainable development, (integrated in landplaning and urbanism tools and laws).

In Europe, the diffusion of these concepts is going with the development of decision making tools. Indeed, the actual trends in geography research and territorial management tend to improve management and prospective tools, in coherence with the requirements of sustainable development. The development of these tools is a consequence of the diffusion of the concepts and computing and information technologies able to analyze and interpret geographical data. This evolution generates new capacities to understand, monitor and represent territorial dynamics. In Algeria, this kind of tools is still not being diffused. Nevertheless, the strong and fundamental specificities which characterize territorial mutations in Algerian Sahara (Kouzmine, 2005; 2007), invite us to develop a specific approach in the comprehension of Saharan territories. This approach is based on concepts of territorial intelligence define as "*the set of the multidisciplinary knowledge which in one hand contributes to the comprehension of spatial structures and dynamics and, in the other hand, wants to become a tool dedicated to the actors of sustainable development of territories*" (Girardot, 2002).

Beyond those general observations, we propose to develop elements about the elaboration of an observatory of territorial structures and dynamics in Algerian Sahara.

2. DEVELOPING COMPREHENSION OF SPATIAL DYNAMICS AND STRUCTURES

Nowadays, many researchers are developing tools able to participate to a more coherent spatial development. The Information System, the Geographical Information Systems (Pornon, 1997; Joliveau 2004) and more participative tools like the Public Participative

G.I.S. (Weiner *et al.*, 2002) belong to a new generation of instruments which is designated to increase (produce) and collect the knowledge about spatial dynamics, in preparation for propose some apposite elements in the making-decision process. These tools are some elements of the territorial intelligence processes. But, the territorial intelligence is not only an instrumented approach and needs firstly some modeling approaches of geographical reality (systemic approach of territory...) to generate appropriate tools depending on the objectives of researchers or territorial actors.

In the Algerian context, between the researchers and territorial actors exists a tacit agreement about the actual and problematic issue of the sustainable development. The Algerian government, in the future National Land planning Scheme, wants to develop instrumented approach of spatial development especially in the “*fragile spaces*” (Mountains, semi-arid spaces like the Algerian steppes, or arid spaces like Sahara). This project will result in the development of databases coupled with G.I.S., especially about the rural spaces (M.A.T.E., 2004c). About the Saharan territories, which are really specific, the scientific research in Algeria develops many research programs also based on instrumented approach about different topics: desertification, water-resources, management of pollutions or urban trashes...

These kinds of methods, or the political will to develop them, are often established on a thematic and/or fragmented approach of the territories. This dimension shaped whole the spatial planning processes and policies (instruments, institutions) in Algeria since the independence, as in Europe over decades. However, the recent political mutations invite to have a new perception of the Algerian spatial planning policies.

2.1. The territory, system and complexity

The territory constitutes a central object in the geographical research. The different evolutions of this concept tended to a more operational definition. The new theoretical perceptions of the territory are based different factors.

The first one is the political decentralization process which tended to create new levels of decision and action on spatial dynamics at national scales (regional, local) and global scale (regional integration, international organizations...). Temporally, this process was concomitant with the reemergence and mutations of the concept of governance (Hermet, 2005). This phenomenon is fundamental to understand the new actors' strategies that tend to make the territory dynamic.

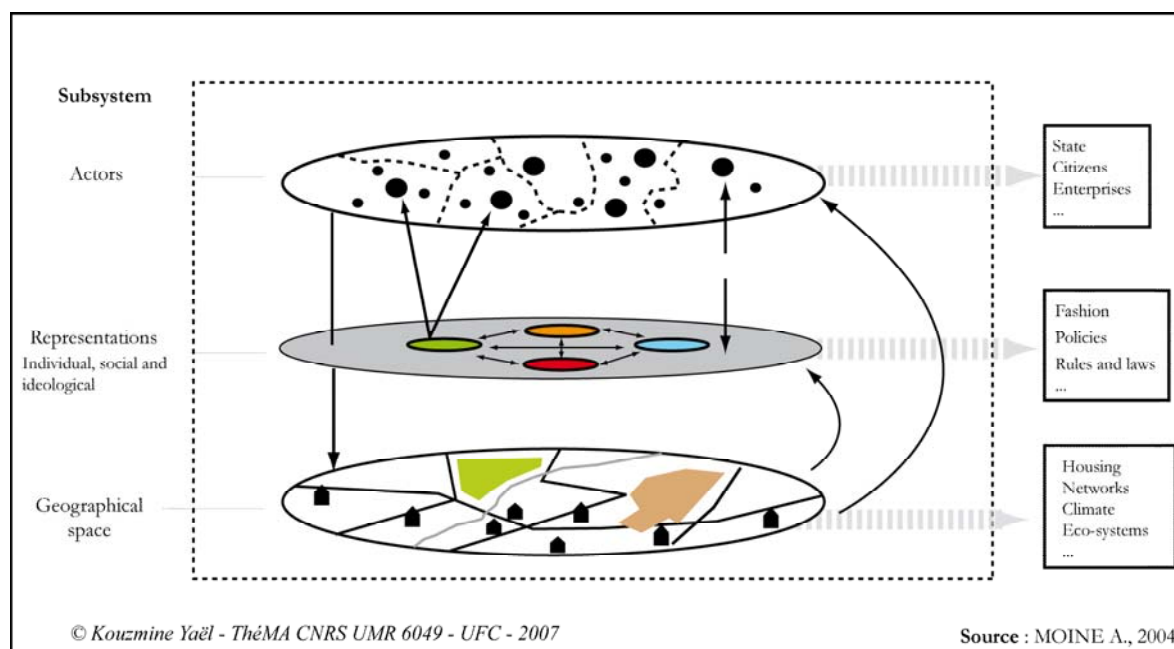
In the same way, the second factor was the come-back of the “actor” on the scene of the territory. He can be:

- Individual: politician, citizen or institutional actor...;
- Collective: grassroots movements, associations (cultural, religious...).

The third factor is linked to the scientific advancements about the issue of complexity of the human systems (Forrester, 1984; Le Moigne, 1990; Morin, 2007). More precisely, in geography, many researchers developed specific elements about the complexity and the systemic approach through their works (Cattan *et al.*, 1999; Dauphiné, 2003; Moine 2006).

Progressively, those scientific works changed the manner to perceive the human phenomenon and by extension the territory.

Fig. n° 1: The territory: a complex system.



The territory is considered as the human societies like a complex system. The systemic approach tends to define a system as a “group of elements in dynamic interactions, organized according to a goal”³³. Another definition invites to understand a system as a “group, forming a coherent and independent entity, of real or conceptual objects (peoples, actions...) organized according to a goal (or a set of goal, projects...) and based on a set of relations (interrelations, dynamic interactions); a system is integrated in a global environment”³⁴. Through these definitions, the territory may be perceived as a system.

Thus, A. Moine (2004, 2006) develops an original analysis of the territory based on the systemic approach. The author considers the territory “as a complex and scalable system which associate in one hand, a group of actors and, in the other hand, the geographical space that the actors use, fit out and manage”. A. Moine has determined three subsystems in constant interactions (fig. n° 1). The first one assemble the actors of the territory (State, Citizens, enterprises, associations...); the second one, “the geographical space”, is formed by the interactions between three subsystems (geosystem, oikumene, social space); the third one is the “representations system” (individual, social and ideological).

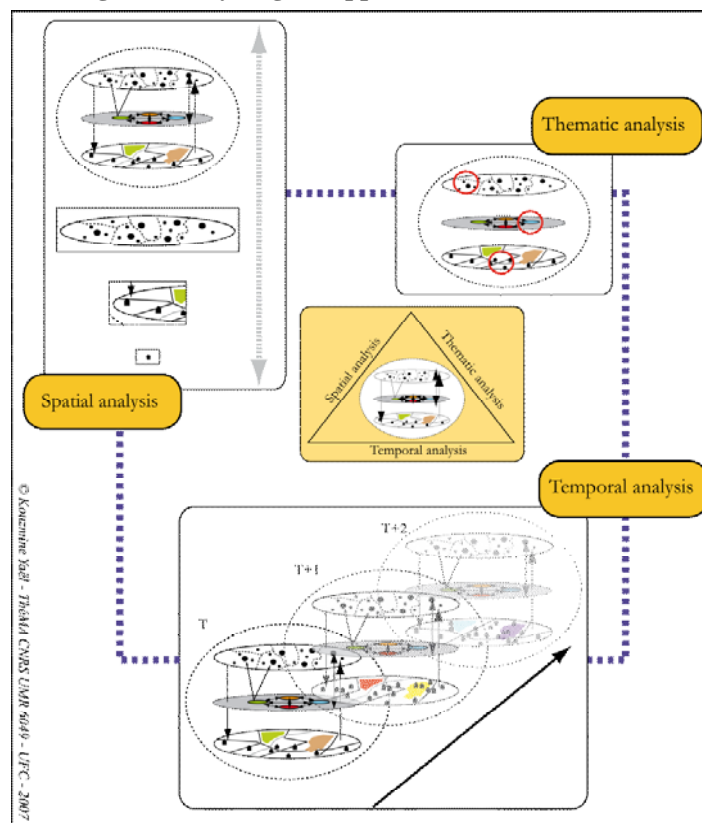
To comprehend the spatial structures and dynamics of the territories, describe as a system, researchers usually use a three level grid able to represent the complexity of the evolution of territories. This approach combines thematic, temporal and spatial dimensions (fig. n°

³³ Donnadieu et Karsky (2002) quote Joël De Rosnay.

³⁴ Donnadieu et Karsky (2002) quote Francis Le Gallou.

2). Many scientific research programs tend to develop a spatio-temporal approach in the tools dedicated to analyze the spatial mutations: G.I.S., P.P.G.I.S., territorial observatory...

Fig. n° 2: A synergetic approach of the territories.



The spatial dimension of the territory is fundamental, and refers to the issue of the choice of pertinent scales to analyze and understand phenomena. Nowadays, in geography exists a crucial debate about the interactions between different spatial scales (micro/macro) and more precisely about the form's emergence. The temporal analysis refers to the dynamic dimension of territories and the evaluation of spatial mutations implies to measure the evolutions at different temporal steps. Finally, the thematic dimension often constitutes the first objective of an instrumented approach of territories. To develop a pertinent comprehension of the territories, a synergetic approach seems to be more efficient than a fragmented approach which not considers the territories as a system based on the constant interactions of his elements.

The term synergetic may be a little bit fuzzy, that is why in this article we will use the term "integrated approach of territory". Four elements allow defining this "integrated approach":

- To consider the territory as a complex system, whereof the elements are in constant interactions;

- To consider the territory not as a separated entity, but as a component of a global environment (a subsystem in more global system);
- To have a transversal and multi-disciplinary vision of spatial problems;
- To integrate a participative dimension in the approach, integrating the different perceptions of partners.

In the large panel of tools which participate to generate a more coherent spatial development, we have chosen to have an approach based on the observation's tools. For us, it seems that the observatories are the most appropriate tool to measure and evaluate the Saharan spatial mutations, approach based on a cooperation with a network of Algerian researchers and institutional actors.

2.2. What is a territorial observatory?

In general, the term "observation" infers to "*the action to watch with attention the people, the things, the events, the phenomena to study and monitor them*"³⁵. The same dictionary define the verb "to observe" by a reference to the actions of monitoring and controlling the phenomenon and process. In geography and other sciences which aim to understand and generate best practices in spatial planning and territorial management, the term "observatory" refers to a specific definition. In that case, an observatory can be considered as an "*observation device create by one or several organisms, to follow the evolutions of a phenomena or a portion of a territory, in time and space*" (De Sède-Marceau *et al.*, 2005).

The development of this kind of tool in Europe increased since few years in the perspective to generate a more coherent territorial development. On one hand, this process is linked to the availability of a increasing volume of territorial data, and in the other hand to the development of informatics capacities to analyze geographical information.

Another element which tends to develop these tools is the political will, based on social needs, to respect the principles of sustainable development. These principles imply to be able to understand more precisely the territorial dynamics and structures, and their evolutions, and to monitor the impacts of public policies. "Observing and monitoring the territories is today one of the most important mission of the spatial planning organisms. To know the condition and the evolution mode of territories through the public policies [...] constitute fundamental politic and strategic objectives. The objective of spatial planning organisms is to dispose of elements able to define the orientation of politics and public investments" (De Sède-Marceau *et al.*, 2005). This kind of approach imply to create partnerships between organizations in charge of territorial management, to support the data cost and mostly to develop a multidisciplinary approach of territorial dynamics. The main objective is to go beyond sectorial approaches to build together what the institutional, thematic and disciplinary approaches not allow.

Except these organization aspects, an observatory must be able to deliver pertinent geographical information formalized by specific indicators. Thus, an observatory can be

³⁵ Dictionnaire Larousse (2004).

considered as an “*organization and communication tools of an indicators system allowing proposing a synthetic and communicative image of territories, to support territorial diagnosis*” (Repetti, 2004). These tools sometimes integrate database and G.I.S., as in the researches lead in Théma Laboratory about observation of territories. They participate to develop more “*supple management methods based on the articulation between global strategies and local management dynamics*” (Repetti, 2004).

The territorial observatories are built on different objectives and technical structures. In practice, it is possible to differentiate two kinds of observatories:

- The production of territorial indicators, the main objective of observation, implies to pool the data produced by different kind of organisms and the partners. This need impose to create structures and organizational mechanisms to allow the building of a device without specific technical tools dedicate to the territorial observation.
- Sometimes, the approach is based on an instrumented dimension. In this way, the observation concept makes reference to the technical tool able to produce information and to participate to making-decision process. The building of the tool firstly must be based on the definition of common objectives with the partners.

3. ONE APPROACH, TWO MAIN OBJECTIVES

3.1. Producing news knowledge about Saharan territories.

Algerian spatial planning policies are still not concretely put into practice tools of territorial management, despite political wills to emphasize that kind of tools. Spatial planning policies applied in Sahara are problematic because they lean upon a very thematic and sectorial vision that is not considering territorial systemic aspects of Saharan territories. Now, it seems that we can't understand Saharan dynamics without including those territorial aspects. That's the reason why we propose to develop a tool able to pool, compare and synthesize information about those territories, in an integrated approach.

The necessity to develop that kind of tool rest upon two other observations:

- First, it's important to note that Saharan territories stir up scientist's interest, not only in Algeria. Indeed, the increasing production of scientific writings demonstrate that gusto³⁶. Despite that several research centers and universities work on these subjects, none structure is able to federate their researches and results.
- Secondly, observation structures are very few developed in Algeria. So, a lot of interesting studies and statistics about Saharan space are barely emphasized and exploited by researcher community and landplanners.

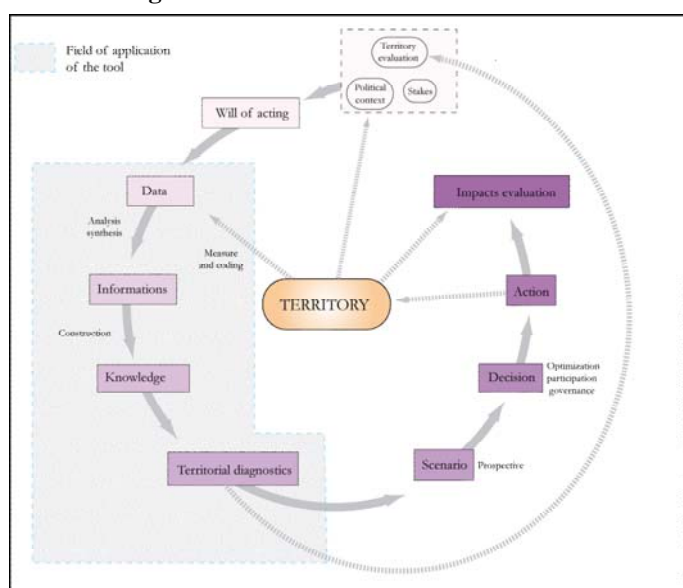
So, increasing knowledge, emphasizing data and information about Saharan territories needs to create a pluri-disciplinary approach, in order to federate the whole data concerning that part of Algerian's space.

³⁶ The Research Network on Saharan spaces' web site (RRESA: resa.org) is inventorying those scientific writings on Saharan spaces.

3.2. Propose some elements in making – decision processes

Only information and data apposite and updated, responding to territorial actors' anticipations, can be used during a decision making process. That means that we have to identify and consider these anticipations in their spatial, temporal and thematic dimensions. Moreover, these aspects must be integrated upstream the tool realization process. Indeed, partners and users' needs determine the structure of the tool. Territorial diagnosis and scenarios constitute some of possible results offered by this observatory. It could help territorial actors to take a decision, based on apposite information available on different forms: maps, graphs, tables.

Fig. n° 3: Stakes of territorial evaluation.



4. METHODOLOGY

The technical structure of the tool rest upon two main aspects (see fig. n° 3):

- A resource-center and;
- A territorial observatory.

4.1. A resource-center

The resource-center rest on “*a strategy of organization, diffusion and valorization of geographical data, as documents concerning territory; based on the mutualization of resources*” (De Sède-Marceau et al., 2005). These resources are human, financial and technical. A such virtual space must be able to stock and make an inventory of the whole data and geographical information concerning Saharan territories. Those information could be heterogeneous, according to their nature (qualitative, quantitative), and their shape (maps, writings, statistics data, pictures).

As part of this project, we propose to elaborate an informatic structure online, in which each partner could unload and download data. This aspect must be got onto a participative approach, which would guarantee a permanent ceaseless improvement of the resource center.

According to De Sède-Marceau *et al.* (2005), a resource-center has to offer the following abilities:

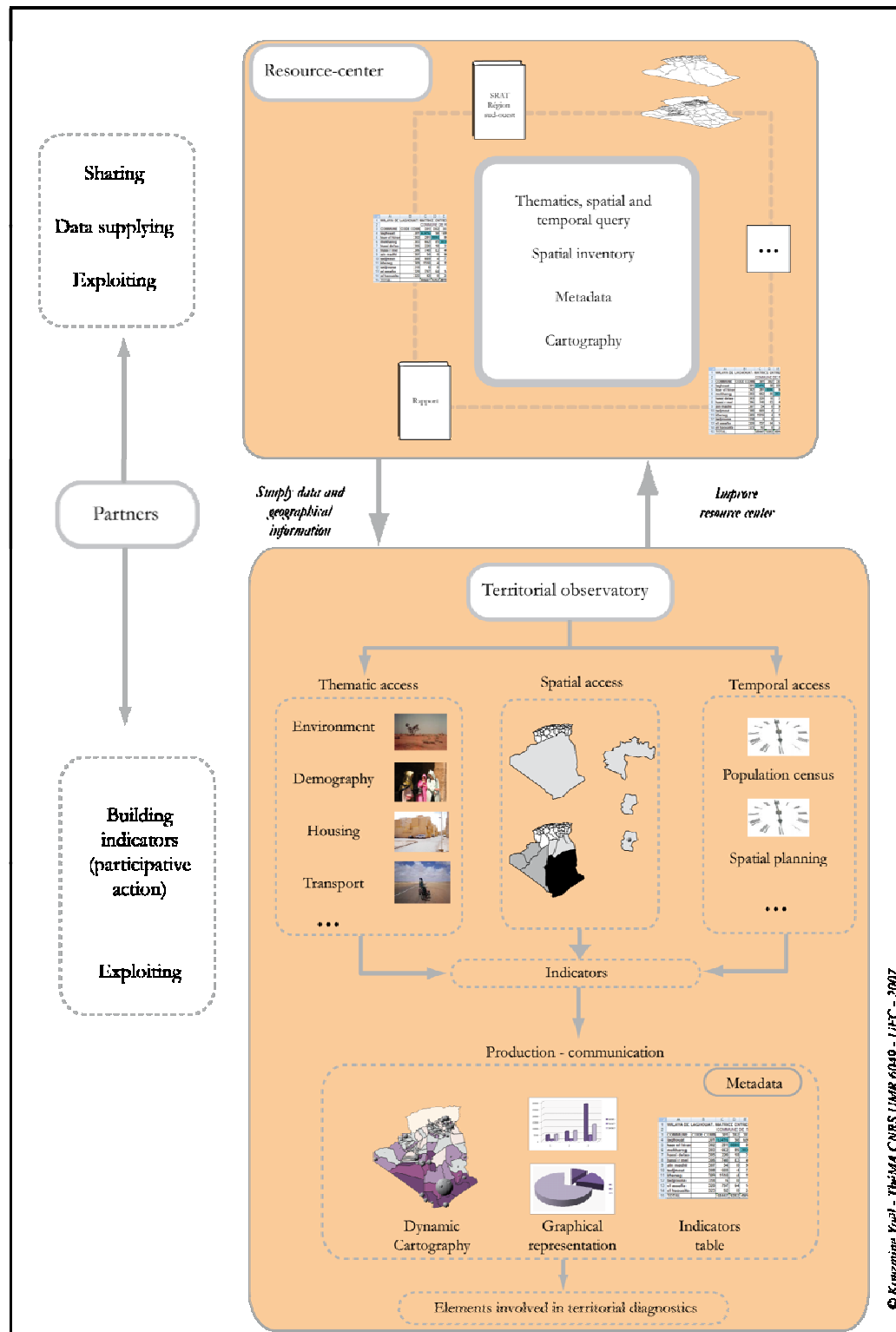
- *“Make an inventory concerning the whole data and documents available in the resource center;*
- *Query some thematic, temporal or spatial requests on the base, and allow the user to access data and documents;*
- *Update the set of data and documents by an user-friendly interface, attainable to everybody;*
- *Upload and download data and documents in order to use them in specific applications”.*

4.2. A territorial observatory

A territorial observatory is a component of a global information system, which is used to product apposite information about a specific theme or spatial entity. The information produced by the system have to respond to expectations of partners: researchers or territorial actors. The database is coupled here with specific Geographical Information System software, able to spatialize geographical information on different scales. The structure we propose rest on a set of geographical indicators, useable on several scales. Those indicators could give a general survey of Saharan territorial dynamics.

The user could access indicators by a thematic, a spatial or a temporal entrance. If the spatial entrance is chosen, the user will have to choose thematic, and then indicators; and conversely in case that the thematic entrance is in the first place chosen.

Fig. n° 4: Technical structure of the tool.



4.2.1. *The indicators and thematic*

Indicators constitute an important element of the observation structure. Joerin *et al.* (2001), define indicator like “*information deemed enough representative and synthetic*” and that aim to “*data and statistics into succinct information that could be easily understood and used by different groups of users*”. Desthieux (2005), specify their main functions:

- **Descriptive**: describe the state of a system, a phenomenon, or of its dynamic by comparing its situation at different times;
- **Illustrative**: implement understanding of interrelations between phenomenon, by measuring correlations between indicators;
- **Prescriptive**: replace the state of system in relation to finalities;
- **Simplification** of information in order to reduce the complexity of phenomenon;
- **Communication** of apposite information in order to interest a large public.

Developing an indicator can be more or less simple. Indeed, it can be «a simple selection of information deemed apposite and representative of a situation³⁷»; but can also recover from a more complex approach (Joerin *et al.* 2001). Composite indicators recover from this second option, since they represent an aggregate of individual indicators emphasized. That kind of indicator is often designed by the term of index.

The creation of indicators must consider the following elements:

- An analysis must be conducted on the relevance of indicators according to spatial scales: the context of data production must be known in case of aggregation of indicators to a bigger scale;
- The presence of data must be analyzed in order to make possible the production of the indicators. The conditions of data production must also be considered to be integrated to metadata (purposes, structure, producer...);
- The aims of territorial evaluation must be clearly defined in amount of analysis, before the construction of the indicator;
- The construction of indicators results from a common approach.

4.2.2. *The spatial scales*

Building a territorial observatory to Saharan scale means to think about apposite spatial scales to take into consideration. We have delimited five spatial level spatially interlocked:

- Three of these levels correspond to administrative levels that have territorial prerogatives (agglomeration, commune and wilaya).
- A second level is constituted by the three “régions-programmes”, made up of several wilayas. Those areas tend to assert themselves as a structure of reflection and partnership in terms of landplaning.

³⁷ For Brunet *et al.* (1998), “*single statistic data is an indicator*”.

- To conclude, the final level considers the whole Algerian Sahara, as defined by J.-C. Brûlé (2004).

The two last levels fit in a perspective of scientific research, tending towards valuating relevance of “*regions-programmes*”, as the coherence of global Saharan space. Integrating those scales of analysis offer some interesting perspectives for researchers.

4.2.3. The temporalities

The temporal dimension is fundamental to evaluate the spatial mutations and will be include in the tool. The temporalities of the data depend on the kind of producer and their objectives. At a national scale, the population census statistics are produce on a long temporal scale (four general censuses since the independence: 1966, 1977, 1987 and 1998), but at a local scales, the actors of landplanning (*wilayas*, town’s department...) produce data more regularly. The Scientifics also produce data and geographical information but in a different temporalities and objectives by comparison with the institutional actors.

Therefore, the tool will not be characterized by temporal scales of reference, each user will can get the data and indicators based on the appropriate temporal scale in regards of his objectives.

4.2.4. Production and communication

In that kind of approach, experience had proved that the reactivity of the tool is very important. Indeed, according to De Sède-Marceau *et al.* (2005), “*the simultaneous acknowledgment of transactions made in the database*” is very important in a context of territorial observation. Reactivity permits a better monitoring of territories’ evolution. It supposes on the one hand a ceaseless updating of data base, and on the other hand the updating of elements produced by the observatory.

The results expected with the observatory are:

- Interactive and dynamic cartography of indicators;
- Data / indicators tables.

The role of maps, based upon indicators, is fundamental in order to build a tool concern with territorial dynamics. The interactive and dynamic cartography allows including the temporal dimension of geographical information. Antoni *et al.* (2004) consider that the most interactive kind of map is the map calculate and built in real-time.

In the tool we propose, the user can generate in real-time his map, based on a spatial scale (five levels) and thematic indicator that he choose. The map on-line allows to get the specific information of the spatial units, as in a classical geographic information system.

The user can also get detailed thematic indicator tables without cartography. These two kinds of elements could integrate a making-decision process by means of territorial diagnostics. In fact, these diagnostics always rest upon cartographic and data elements.

5. PARTNERSHIPS

This project is included in one international research program. The “Partenariat Hubert Curien Tassili” (n° 07-MDU-710) started in 2007 in cooperation between the ThéMA laboratory (UMR 6049 CNRS – University of Franche-Comté) and the Research center in cultural and social anthropology (C.R.A.S.C. – Oran, Algeria). This project deals with the territorial dynamics in the south-western Sahara. One of the scientific actions is the development of a territorial observatory in this region. The region is considered as a first case study, before to develop the tool to a larger spatial scale. In this cooperation action, we work with researchers from the C.R.A.S.C. and from the “Geographic space and spatial planning Laboratory” (E.G.E.A.T.) at the Es-Senia University (Oran).

In the future, we will try to create a partnership with the United Nations Development Program (P.N.U.D.) which develops programs about local development in Algeria.

CONCLUSION

This original project in Algeria involves developing partnerships between researchers and institutional actors of the Saharan territories. The first steps describe in this article constitute the theoretical bases of the future development of the tool in collaboration with the Algerian universities and local actors of territorial development. The first action is engaged to create the territorial indicator system specifically dedicated to the Saharan territories in Algeria. The second approach need to assemble whole the data which are produced by researchers and territorial actors to define the ability of the indicators to describe the reality of Saharan territorial dynamics.

Our instrumented approach is based on the concept of territorial intelligence applied to territories which are characterized by strong mutations and specificities. Our researches tend to transfer the methods of territorial intelligence based on observation tool in a different territorial context than they are usually applied.

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